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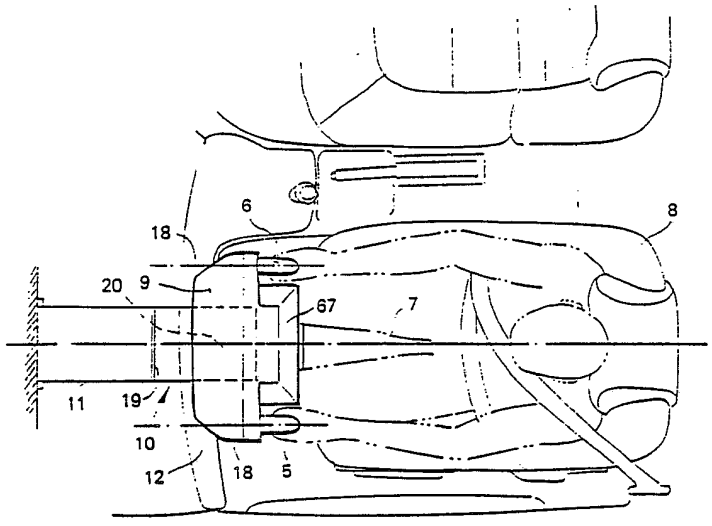

(57) Abstract

A steering control for automobiles, which by means of signals acts upon a steering gear for steering the wheels of the automobile, comprises two control sticks (5, 6) suspended in front of the driver's seat, which are interconnected so that they follow each other slavishly. The control sticks are swingable sideways about axis lines (18) directed forward and extending through the part of the control sticks that is gripped by the driver, the axis lines forming elongations of the driver's forearms. The control sticks are so designed that they constitute rests for the hands and give a reference as a help to precise controlling.

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Automobile steering control

The present invention relates to an automobile steering control which is arranged to preferably electricly act upon a steering gear for steering the steerable wheels of the automobile.

More exactly, the invention relates to a steering control which is composed of two control handles, each of which is movable relative to its own axis line extending along and to the left and right, respectively, of a vertical plane extending forward through the centre of the driver's seat, and which control handles are interconnected so that they follow each other slavishly when the controlling movements are performed on either alternatively both control handles.

Ever since the automobile became a means of communication, its steering control has been mechanically working and has comprised a steering wheel whose turning movements are transmitted to the wheels via a gear or the equivalent. In modern cars, hydraulic servo-units are sometimes used, which facilitate controlling in that they enforce the power transmitted from the steering wheel.

As of late, there have come up proposals on control systems in which all or nearly all the power required for manoeuvering the wheels is produced by servo-motors, preferably electric, which interact with the steering gear. It is understood that in such a system the conventional mechanical coupling between the steering control of the automobile (the steering wheel) and the executing means (the steering gear) and instead let the latter work through electric signals that are produced on steering control movements.

An essential advantage by such an arrangement is the greater freedom offered in design, adaptation to the driver and instal-

lation of the steering control, all compared with conventional control systems with a steering wheel. That understood, the invention seeks to produce an automobile steering control of the kind mentioned by way of introduction and which can replace the steering wheel.

Through the American patent No. 3,312,123 an automobile steering control is earlier known with two ring-shaped control handles, which are rotatable on forward-directed parallel axles. The rotating movement of the control handles, which can be a number of revolutions, is transmitted via a chain transmission to a common axle which corresponds to the steering-column in a conventional automobile steering control and which effects mechanically the steering gear of the automobile. The ring-shaped control handles, which the driver can grip with his fingers stretched forward on the periphery of the handles, are formed with a cavity for the thumb or other finger in order to facilitate controlling. The construction does not provide the steering control with the desired steering qualities and has not, as far as is known, taken practical shape.

The present invention has as its object to obtain the following advantages in the steering control compared with conventional wheel steering controls:

- improved controlling qualities including better controlling precision, higher controlling speed and better stability during varying driving conditions;

- improved driver environment through more appropriate arrangement of instruments, control boards and collision protection means, and enlarged leg space;

- improved driving safety and driving comfort of driving due to better controlling qualities and better driver environment.

Those objects are obtained according to the primary characteristics of the invention by forming each control handle with a control stick part, which is essentially directed upwards in the neutral position of the automobile steering control - i.e. when the steerable wheels are directed forward - is swingable sideways towards and away from said plane and is intended to be gripped by the driver's hand on performing controlling movements, and with resting means constituting the lower part of the control handle and intended to define the elevation position of the driver's hand when it grips the control stick part.

According to other important characteristics of the invention, irrespective of the controlling movements, both control sticks are parallel or principally parallel to each other and suspended from axles which are equally situated and preferably parallel relative to said plane and which are directed forward, so that each axle forms a straight or almost straight elongation of the driver's forearm when the automobile is being controlled.

Another important characteristic of the invention is that the control sticks in a neutral position where they are parallel or principally parallel to said plane stretch in a direction somewhat tilted forward and have a relative distance of about 30-50 cm, so that the driver can grip the control sticks with his hands and arms directed principally forward.

In an automobile steering control with the above indicated characteristics the neuro-motoric organs in the human body that are the most suitable to precise and quick steering are advantageously used, namely those responsible for the muscular work and movements of the hand and fingers. Three sense-functions are important for the steering function and the steering information; With the sense of feeling we register pressure on the skin, with the muscle sense the load weight on the muscles, and with the kinesthetic sense the orientation of

the parts of the body, e.g. the angular position of the hand. With the steering control according to the invention, forces and amplitudes of movement suitably adjusted to those senses will be produced during steering. That applies to maximum values as well as gradients on changes of condition.

By replacing the conventional control system with a steering wheel by a system with two sideways separated control sticks, one obtains that the space in front of the driver's seat can be disposed more freely for other equipment important during driving, such as instruments which no longer have to be blocked out to the driver, as well as the safety arrangements with inflatable cushions that have emerged recently to protect the driver and the front-seat passenger in the event of a collision.

It should also be pointed out that with a steering control with two control sticks that are swingable sideways, one retains the possibility, which now exists with a wheel steering control, for the driver to hold on to the steering control with both hands to prevent the body from falling forward in a situation with strong retardation, e.g. on a sudden braking or an immediately impending head-on collision.

According to other characteristics of the invention each control stick in its lower part is formed with a rest for the driver's hand, which rest comprises a resting surface turned upwards and directed at an angle to an upper control stick part formed as a handle, which resting surface serves to define the elevation position of the hand when it grips the control stick. That elevation position is important. The axis line for each control stick shall therefore intersect the section of the control stick that is intended to be gripped by the driver's hand, preferably in an elevation position such that the part of the hand that will be below the axis line constitutes 1/3 of the elevation of the hand.

The rest for the hands can further be movable together with

the upper control stick parts or be rigid, alternatively rigid within an inner angular range around the neutral position of the control sticks and movable with the upper control stick parts when there are controlling movements outside the inner angular range, whereupon in these alternatives the rest can be formed by the lower control stick parts. Irrespective of which alternative, the movement of the upper control stick parts, formed as handles, is detected in order to produce a steering command.

According to a special characteristic the upper control stick part on the side turned away from said plane down in its lower part, can be formed with a shelf which constitutes said resting surface turned upwards and serves as a rest in elevation for the wrist, while the lower part of the control stick is so formed on the side facing the plane, that it can be gripped by at least the little finger and provide a rest horizontally, and with said rest as a reference the driver can feel the steering movements.

The resting function obtained through the last mentioned characteristics is important. The resting surface, which according to the above defines the position of the hand, makes possible an optimal use of the sensitivity of the resting surface, and in the combination with a rigid rest steering performance will be improved further in that there will be a valuable reference for precise control stick deflections. During driving, the rests on the control sticks damp disturbing effects of bumps in the road-way and also of side forces in sharp turns.

By forming each control stick so that its axis line will pass through the lower part of the control stick and of the hand a controlling movement can be precise and quick at the same time. That provides for good stability and controlling qualities. With a conventional steering wheel, where the hand is located at 15-20 cm from the centre of movement (the steering wheel

hub), translatoric movements in the hand and thereby also movements in the arms are principally used during steering. Precision in a controling measure will therefore be not so good. The hand must be moved a longer way in order to obtain acceptable precision and stability. Farther hand movements take a longer time, however, and time delays deteriorate performance in all control systems. Furthermore, there must be a change of grip when to make larger steering wheel movements, e.g. in an ordinary turn round a street corner, and it is understood that changes of grip are disadvantageous in that they cause further delays and deteriorate the controlling qualities. With a steering control according to the invention the driver is not forced to change grip but, during driving, irrespective of the size of the controlling movements, the driver can keep the grip of the control sticks in a well-defined position on those.

The driver has at his disposal, according to the characteristics of the invention, two suitably formed control sticks which follow each other slavishly, and which the driver, in accordance with the existing conditions, by his own choice can operate with both or either hand. The steering control presents thereby substantial advantages from an operational point of view, compared with controlling with only one control stick. Therefore it will be easier for the driver without changing the controlling movements to use the left or right hand for other things than controlling and also it provides a possibility of variety in the monotonous task that the driver has during long-time driving. Two control sticks facilitate also parking manoeuvers and reversing. Hereby the driver must be able to turn his head and upper part of the body to get a good vision backwards. The turning of the body and the controlling will therefore be easier if he can steer with one hand gripping the control stick that normally is intended for the other hand. Generally speaking, improved safety and better flexibility of use are obtained by having access to two interconnected control sticks which can be used optionally by the driver.

The aim that the steering control shall act upon the steering gear of the automobile non-mechanically is achieved according to the invention through a transmission device, preferably electric, that senses control deflections and produces signals that are dependent on the angular position of the control sticks. Suitably, the transmitter is combined with the coupling device.

Within the scope of the present invention there is, furthermore, a possibility to arrange a coupling device which is safe and simple and which will be admitted in the space between the control sticks, as well as to find a building-in arrangement of the steering control that makes it adaptable to the interiour of the car and to the driver's personal preferences of seating position. According to special characteristics of the invention the coupling device is mechanical and comprises transverse elements, preferably a link which in its ends is flexibily connected to the control sticks. The coupling device and the control sticks and axles are suspended from a bracket, which comprises a box-shaped housing surrounding the axles, the coupling device and the signal transmitter. The construction allows the steering control to be adjusted in elevation and in the longitudinal direction of the automobile for said adjustment to the driver's seating position.

Other characteristics within the scope of the invention will be evident from the description below.

The invention will now be described further with reference to the accompanying drawing on which

figure 1 is a perpective view of the driver's seat in a automobile with a steering control according to the invention;

figure 2 and 3 show the same driver's seat in a view from the side and from above, respectively;

figure 4-7 and 14 show in perspective different embodiments of the steering control according to the invention;

figure 8-10 illustrate diagrammatically the movement geometry of the steering control in different embodiments of control sticks;

figure 11 is a perspective view of a control stick in one embodiment;

figure 12 shows angular resolutions for the control stick parts;

figure 13 shows curves of different movement relations for the control stick parts.

The drawing illustrates the application of the invention in a conventionally built passenger car but the invention is not limited hereto but relates also to other kinds of automobiles, such as sports-cars, racing cars, lorries and cross-country vehicles, trucks etc.

On the drawing, 1 designates generally a steering control according to the invention which is arranged to act upon the steering gear 3 of the car via a signal connection 2 which preferably consists of an electric wire. The steering gear is combined with servo motors (not shown) which are also preferably electricly working and arranged dependent on the command signals produced by the steering control to the steering gear to execute turning movements, corresponding to said signals, of the steerable wheels 4 of the automobile.

The steering control 1 comprises according to the primary characteristics of the invention two control sticks 5 and 6, provided on the left and right sides, respectively, of a vertical plane 7 which extends forward from the middle of the driver's seat

defined by the seat 8. The control sticks are suitably mounted in a box-shaped housing 9 comprised in a bracket 10 and extending from the plane 7 to the left and to the right somewhat passed the control sticks. The bracket goes out from a hold 11 in the automobile body which hold extends along the plane 7 under and in front of the dashboard 12.

The steering control comprises further according to the primary characteristic a coupling device, generally designated 13 in figure 4-10, which is arranged to connect the two control sticks 5 and 6, preferably mechanically, so that the control sticks follow each other slavisly in the controlling movements, which movements are effected through swinging sideways towards and away from the vertical plane 7. The driver can thus steer the car through controlling movements to the left and to the right which he can perform with both hands gripping the control sticks, as is shown in figure 3, or by using only one of the control sticks. The construction allows him, in the latter case, to grip the control stick with optional hand or move one hand from one control stick to the other when needed.

That flexible way to operate a steering control have advantages for the driver, which have been described above, and with regard to this among other things, the control sticks should be parallel to the vertical plane 7 in the neutral position, that is during driving straight forward, and in every other position said control sticks should be parallel or principally parallel to each other.

In the basic embodiment of the steering control shown in figure 4 the control sticks 5, 6 are suspended from axles 14 and 15 which in their front and back ends are supported in ears 16 and 17 belonging to the bracket 10. The axles are located equally relative to the plane 7, preferably with a relative distance of 30-50 cm, and with respect to the relative connection of the control sticks, it is to be preferred that axles and said plane are parallel.

The axles should further be directed forward or somewhat tilted upwards, as seen from the driver's seat 8, so that the swinging centre 18 of each axle as shown in figure 2 forms a straight or almost straigh elongation of the driver's forearm when he takes a seating position suitable for driving. To obtain such an adjustment of the position of the axles the driver should not have to adjust the seat but instead, by vertical, interlockable steering parts on the bracket 10 and the fixed part 11 (at 19 in figure 2-3) he can adjust the elevation of the bracket and thereby also of the control sticks. Analogously, the control sticks can be moved backwards or forward through steering parts (at 20) on the bracket and the housing 9, so that the arms will have a restful position well adapted to steering.

The coupling device 13 comprises at least one movement-transferring element extending at an angle to the plane 7, which in the basic embodiment according to figure 4 is a link 21 which in its ends is flexibly connected to two equally long levers 22 extending in parallel directions from the control stick axles 14, 15. The latter are in this embodiment connected to the control sticks through elongation parts 23, 24 stretching forward from the upper and lower ends, respectively, of each control stick and which are joined with a closed clamp at a distance from the control sticks which makes it easy for the driver to insert his fingers and grip the stick. The attachment between clamp and axle shall be done so that the elongation backwards of the centre line of the axle, i.e. the swinging centre 18 in figure 2, will go through the lower part of the control stick, preferably in such a position that the part of the hand that will be below said centre will be 1/3 of the elevation of the hand. In the basic embodiment, as is shown in figure 4, the elongation part 24 is combined with a rest 25 for the hand forming a resting surface 26 turned upwards and directed at an angle to the control stick part 27 above, formed as a handle. The rest and the handle part are here made

in one piece and will therefore follow the controlling movements, whereby the resting surface 26 gives to the hand a well-defined elevation position. The control sticks should be reverse images of each other in the vertical plane 7 to fit the hands.

The steering movements are detected by way of an electric transmission unit which in order to give a redundance in the control system should consist of at least two separate transmitters 28, both comprising a part 29 fixed in said bracket 10 and a part 30 turnable relative to the fixed part. The turnable part is acting through an arm 31, which has a length equal to the levers 22, and a pivot 32 movably connected to a bearing 33 in the link 21. Each of the turnable transmitter parts is thus made to rotate an equally large angle on a controlling movement, whereupon a command signal representing the controlling movement is emitted via the wire 2 to the steering gear 3.

Similarly, in the coupling device is mounted a damping means 34 that can work electricly or mechanically and which, like the transmitters, has an immobile part 35 and a turnable part 36 which is carried over when there are controlling movements. Hereby the control stick movements are damped, and through a suitable characteristic of the means, quick angular changes that would be inappropriate can be prevented in the control system while there will be no effect on slow changes in the angular position.

The movement geometry in the basic embodiment is illustrated in figure 8 which shows diagrammatically the control sticks 5 and 6 in the neutral position. From there the control sticks can be swung about their axis lines 18 an angle α which is equally large in both directions and can be up to 60°, whereby the extreme positions, naturally, should correspond to the maximum turn-out of the wheels of the car. By such a large angle of deflection there can be a simple relationship between the command signal, emitted from the steering control, and

the turning of the wheels.

The steering control can be equipped with means that strive to bring back the control sticks to the neutral position. Such means are shown in figure 4 as two springs 37 and 38 which are stretched between the left and right control stick, respectively, suitably at protrusions 39 on the axles, and a centrally located hold 40 in the bracket 10. By such an arrangement the driver feels a resistence which increases with larger and larger control stick deflections and the centred spring force makes it easier for him to drive straight forward. Instead of springs other mechanical or electric centering means can be used, e.g. torque motors which are acted upon by a signal from the control system.

As is evident from the drawing the coupling device 13 in its entirety is located in the space between and above the axles of the control sticks 14, 15 and the steering control can be limited downwards by a smooth bottom 41, extending along the axles, in the bracket. In comparence wich a wheel steering control a better leg space is hereby attained which facilitates climbing in and out.

In a second embodiment, shown in figure 5, the control sticks are made in two pieces, one upper part 42 which is formed as a handle part and a lower part 43 which by analogy with the resting part 25 in figure 4 forms a resting surface 26. Compared with that the embodiment in figure 5 is based on different movement geometry, namely that illustrated in figure 9.

As is evident from the last-mentioned figure the lower control stick part 43 is movable out from the neutral position to an angle $\pm\beta$ which is considerably smaller than the angle α for the upper control stick part 42, where the construction shall be such that the lower part in an down-geared relationship, e.g. 1:2, follows the upper part. Its movements are faithfully trans-

mitted, as before, between the two control sticks through the coupling device 13 and are transformed into command signals.

With that geometry and irrespective of at what angle the control stick is located, the driver can feel through the sensors of the hand, the relative movement that appear on every change of the angle, and thus he will have a reference by the resting surface 26 on the lower part 43 which contributes to a better controlling precision.

The coupling device 13' based on the geometry in figure 9 comprises two concentric axles for each control stick, namely an outer tubular axle 15', which similarly to the axle 15 in figure 4 is turnably attached in the bracket 10 but differing in that it has a recess 44 in its front part. The axle is rigidly connected to the handle part 42 via the upper elongation part 23. An inner axle 45 is supported in the outer axle and is rigidly connected to the lower control stick part 43 via its elongation part 24. Furthermore, there are included three links which relatively connect the axles, namely a first link 46, which is provided between equally long supporting ears 47, 48 on the two outer axles 15', and which link 46 therefore forces the handle parts 42 to follow each other slavishly, a second link 49 which is provided between equally long levers 50, 51, which are attached on the two inner axles 45 and stretch outwards through the recesses 44, and which link 49 causes the lower control stick parts 43 to move relatively in a relationship 1:1, and a third link 52 which is connected between one of the supporting ears 47 or 48 and one of the levers 50 or 51. Due to the levers having twice the length of the effective length of the supporting ears, each angle movement, which is transmitted translatoricly by the third link 52 to the lever 50 or 51 on controlling movements on either of the upper control stick parts 42, will give only half as large an angular movement of the inner axles 45 and thereby on the lower control stick parts 43. The detection and damping of the controlling movements can be effected in a manner similar to that in the

basic embodiment with transmission and damping means 28 and 34, respectively, connected to the first link 46.

Also in a third embodiment of the steering control which is shown in figures 6 and 10, the control sticks are composed of two separate parts, an upper handle part 53 and a lower part 54. The movement geometry as well as the coupling device 13' here be similar to the one just described and, as is shown in figure 6, the lower control stick parts are here unturnably connected through clamp parts 55 to the inner axles 45 which by analogy with the above turn a smaller angle than the outer axles. The arrangement includes a secondary transmitter 56 which is mounted in the bracket and which, with an arm connected to the third link 52, detects the position of the lower control stick parts 54. The produced signal can have a supplementary function in the control system for the manoeuvering of the wheels.

Alternatively, as suggested in figure 10, the lower control stick parts 54 can be rigidly mounted in the bracket 10, the purpose being to provide a additional rest for the hand which complements the resting function that is provided by the resting surface 26 on the control stick parts 53, which in this embodiment is formed to a shelf 57 on the outside of the control stick below the swinging centre 18. For this purpose, the opposite sides of the lower control stick parts 54 have an undercut section 58, located between the clamp part 55 and a thicker acorn-shaped section 59, above which the recessed end on the control stick part 53 can glide during the controlling movements. The grip of the hand around the control stick will hereby be such as is evident from the perspective picture in figure 11.

With the wrist resting on the shelf 57 the driver can grip with the little finger and possibly also the ring-finger the undercut section 58 on the same time as the inside of the hands

and fingers grips the acorn-shaped section 59. Said two sections will thus support the hand horizontally and effectively contribute to giving it a well-defined grip position. Also the reference function explained above in relation to figure 5 is improved.

A fourth embodiment of the steering control, shown in figure 7, differs from the one last described only by the coupling device 13" and the consequently changed movement geometry. The lower control stick parts which are designated here by 60 are also here movable together with the upper parts 61, however not at small angles within an inner angular range around the neutral position.

Purely principally, that can be achieved by removing the third link 52 in figure 6 and let the first link 46 move freely relative to the second link 49 a certain distance, in figure 7 designated by s, to the left and to the right from the neutral position. The distance s and thereby the inner angular range is defined by two heels 62 on the second link and a pin 63 protruding from the first link. During movements on the pin smaller than s the inner axles 45 and the lower control stick parts 60 stand still, which can be certified by connecting centering means, e.g. springs as in figure 4, between said axles and control stick parts. It is understood that as soon as the controlling movements are larger than corresponding to the distance s the pin 63 will carry over the link 49, the axles 45 and the lower control stick parts 60 which will now follow the outward movement of the upper control stick parts. During the returning movement inwards a spring 64 located on each side of the heels 62 causes the lower control stick parts to be brought back to the neutral position, whereupon small relative movements can start again between the two parts of the control stick.

The embodiments according to the above, with the lower control

stick parts being rigid or rigid within an inner angular range around the neutral position for the upper control stick parts but being movable out of that range can also be applied on embodiments of control sticks according to figure 5.

In the embodiments above have been described movement relations between the lower control stick parts (angle δ_2) and the upper control stick parts (angle δ_1) according to the curves A and B in figure 13. A most appropriate movement relation is shown by the curve C in said figure. It is an unlinear function which has a shape lying between the curves A and B, by which the following advantages are attained. Firstly, the function is continuous and lacks skip-wise gradient exchanges as curve B, which can disturb the control function. Secondly, the lower control stick parts are nearly rigid for small controlling movements on the upper control stick parts. The resting function will therefore be the best within this area where fine-controlling is the most important. Thirdly, the lower control stick parts follow the upper ones more and more for large controlling movements on the upper control stick parts, which causes a suitable limitation of the relative movement between the control stick parts.

A fifth embodiment of a control stick for a steering control according to the invention which provides that function is evident from figure 14. With that construction the lower control stick part 43 can follow the movement of the upper control stick part 42 in such a way that the angular deflection of the upper control stick part from a neutral position δ_1 causes an angular deflection δ_2 according to an unlinear function, which is evident from figure 13, curve C. The angles δ_1 and δ_2 are illustrated in figure 12. Said unlinear function can in itself be obtained in different ways, and in figure 14 a construction is shown which comprises a camshaft pulley 69, being controlled by a link 70 that is movably connected to the lower part of the camshaft pulley 69 on the one hand, and in an arm 71 on the other hand, which arm has a rigid turning

connection to the upper control stick part 42. A link 72 transmits the desired movement function, by way of a roll 73 that follows the camshaft pulley 69, to the lower control stick part via an axle 74 coaxial with an axle 75, which is turnably fixed to the clamp 23, which in turn is rigidly connected to the upper control stick part 42. In order for the roll 73 to follow the camshaft pulley 69 the link 72 is spring-loaded by a spring 76.

Irrespective of what embodiment is given to the control sticks, it may be advantageous to build in, at least in one control stick, those controls or function switches which the driver needs to operate during driving. Such controls and switches can be used for speed-keeping, speed control and braking function and can also be used for direction indicators, wind-screen wipers and signal horn. In figures 1 and 11 is shown at 65 an example of how the control knobs for such functions can be arranged so that the driver can operate them with his thumb simultaneously with controlling the automobile and gripping the control stick. In figure 1, 66 represents other control knobs which are built into the exterior of the housing 9 so that they will be easily accessible to the forefinger or middle finger during driving.

With reference to figure 1 it should eventually be pointed out that the box-shaped housing 9 can have a centrally located section 67, which is a projection backwards from the transverse part of the housing that surrounds, among other things, the control stick axles and the copuling device. The central section, where it may be suitable to arrange a collision protection means in the form of an inflatable cushion or an equivalent safety device, is limited sideways with respect to the maximum angle of deflection of the steering control. The housing has therefore recesses 68 which in accordance with the drawing are open backwards and at the sides and are so wide that the central section cannot interfere with controlling. It is understood

that the steering control according to the invention in a combination with a safety device of the kind mentioned above has the advantage compared with a wheel steering control that the safety device will be stationary and can therefore act upon the driver in a similar way in every angular position of the wheels.

In order to elucidate the advantages by control sticks made up of two turnable parts the functions will now be described somewhat more particularly. In this section the upper control stick part is called control part and the lower control stick part is called resting part. The resting part has four functions according to the following. A first function is to fix the elevation position of the hand and to give a rest to the wrist down in the lower part, which provides a comfortable hand grip during controlling. A second function is to provide a rest for the hand that damps disturbing effects on the steering by exterior forces, e.g. by bumps in the road-way and sidewind gusts. A third is to provide a reference for the hand during operating the control part. Through above-mentioned senses the driver feels the relative movement between the control part and the resting part. Hereby performance is improved, and that implies both to quickness, precision and stability on operating. A fourth function is to provide a particularly steady grip for the driver during heavy controlling with accompanying great forces on the automobile and the driver. Such a steady grip has two advantages. Firstly the possibilities for the driver to retain a good and desirable position in the driver's seat during forceful manoevering are improved. Secondly the steady grip of hand facilitates for the driver to feel through the sensors of the hand the forces on the car, e.g. side forces, during manoeuvering. That information is important for the steering function.

The four described functions of the resting part are advantageous for the steering qualities if the driver controls with one control stick or with two control sticks. The fourth function

is naturally the best when using two control sticks and both hands because then the driver will have the steadiest grip.

The above described functions of the resting part will be put to the best use if it is rigid. A certain small movement can also provide good resting functions. The main reasons for a certain movement are that the control part with respect to the steering function requires a range of movement of about ±60 degrees and that the relative movement between the control part and the resting part must not be too large, at the maximum about 30 degrees, with respect to demands on a more appropriate and comfortable hand grip. The maximum turnability of the control part must be dimensioned for manouvering situations with demands on maximum wheel-turning, e.g. parking and controlled skid. In a control system - preferably electric - which can include the control sticks according to the invention it is possible to use speed-dependent functions in order to control the relation between the wheel angle and the control stick angle. Other special so-called steering-law functions which have effects on the control-stick qualities, e.g. output signal gradient and control-stick-measure gradient, can be used for an optimal adaptation to the human sensors and sence functions. In spite of such possibilities there is a risk by reducing the maximum controlling movements of the control part to below that indicated above, i.e. ±60 degrees. A reduction by half, which would allow of a rigid resting part, could result in a control system which would be too sensitive. It would therefore be difficult to control and in certain cases possibly unstable.

From the above-mentioned it follows that the best steering qualities can be obtained by two-piece control sticks separated according to the invention, where the control part has a maximum turnability of about ±60 degrees for good steering function and the resting part has a turnability of about ±30 degrees. The relative movement between the control part and the resting part is then about 30 degrees. The described embodiments of

the invention are examples of variants with appropriate movement relation between the control parts and the resting parts.

Furthermore, it follows that the given object of the invention is to gain advantages compared with conventional wheel steering controls through better manoeuvering qualities, driver environment, driving safety and driving comfort, which object is best achieved by two two-piece control sticks located on either side of a vertical plane extending forward from the centre of the driver's seat, the control sticks being relatively connected in order to follow each other's movements when the driver is controlling the automobile.

Claims

1. An automobile steering control which is arranged to preferably electricly act upon a steering gear for steering the steerable wheels of the automobile and which is composed of two control handles, each of which is movable relative to its own axis line extending along and to the left and right, respectively, of a vertical plane extending forward through the centre of the driver's seat, and which control handles are interconnected so that they follow each other slavishly when the controlling movements are performed on either alternatively both control handles, c h a r a c t e r i z e d in that each control handle is composed of a control stick part which is essentially directed upwards in the neutral position of the automobile steering control - i.e. when the steerable wheels are directed forward - is swingable sideways towards and away from said plane and is intended to be gripped by the driver's hand on performing controlling movements, and with resting means constituting the lower part of the control handle and intended to define the elevation position of the driver's hand when it grips the control stick part.

2. An automobile steering control according to claim 1, c h a r a c t e r i z e d in that the control sticks (5, 6) are suspended from axles (14, 15; 44, 45) which are equally situated and preferably parallel relative to said plane (7) and which are directed forward, so that each axle forms a straight or almost straight elongation (18) of the driver's forearm when the automobile is being controlled.

3. An automobile steering control according to claim 1 or claim 2, c h a r a c t e r i z e d in that the control sticks (5, 6), irrespective of steering movements, are parallel or principally parallel to each other.

4. An automobile steering control according to any one of claims 1-3, c h a r a c t e r i z e d in that the control sticks (5, 6) in a neutral position where they are parallel or principally parallel to said plane (7), strech in a direction upwards, preferably somewhat tilted forward, and have a relative distance of about 30-50 cm so that the driver can grip the control sticks with his hands and arms directed principally forward.

5. An automobile steering control according to any one of claims 1-3, c h a r a c t e r i z e d in that the coupling device (13) is mechanically working and comprises elements extending at an angle to said plane, the elements preferably being in the form of at least one link (21; 46, 49, 52) which in its ends is flexibly connected to the control sticks (5, 6) and is situated at a level above the axles (14, 15; 44, 45).

6. An automobile steering control according to any one of claims 1-3 or claim 5, c h a r a c t e r i z e d in that the steering control has at least one transmitter (28) which is arranged to detect the steering deflections of the control sticks (5, 6) and to emit to the steering gear (3) a signal that is dependent on the angular position of the control sticks.

7. An automobile steering control according to any one of claims 1-4, c h a r a c t e r i z e d in that each control stick (5, 6) down in its lower part forms a rest (25; 43; 57) for the driver's hand, which rest comprises a resting surface (26) turned upwards and directed at an angle to an upper part of the control stick (27; 42; 53; 61), the upper part being formed as a handle, and which resting surface serves to define the elevation position of the hand when it grips the control stick.

8. An automobile steering control according to any one of claims 2-4 or claim 7, c h a r a c t e r i z e d in that the axis line (18) for each control stick (5, 6) intersect the part of the control stick that is intended to be gripped by the driver's hand, preferably in an elevation position such that the part of the hand that will be below the axis line constitutes 1/3 of the elevation of the hand.

9. An automobile steering control according to claim 4, c h a r a c t e r i z e d in that each control stick (5, 6) is swingable within an angular range (α) of 45^{o} to 60^{o} to the right and left from the neutral position, which range corresponds to the angular range within which the steerable wheels can be turned out.

10. An automobile steering control according to claim 6, c h a r a c t e r i z e d in that the transmitter (28) comprises a rigid part (29) and a part (30) that is turnable relative to it and connected to either of the control sticks (5, 6) or said element (21) in the coupling device 13.

11. An automobile steering control according to claims 7 or 8, c h a r a c t e r i z e d in that the lower part of the control stick that forms said rest (25), and the control stick part (27) that is formed as a handle are made in one piece.

12. An automobile steering control according to claims 6 and 7 or claim 8, c h a r a c t e r i z e d in that the upper control stick part (42; 53; 61) that is formed as a handle part is movable relative to the lower part (43; 54; 60) of the control stick, and in that the movement of the upper part is detected as steering deflections by the transmitter (28).

13. An automobile steering control according to claim 7 or

claims 8 and 12, c h a r a c t e r i z e d in that the upper part of the control stick part (53; 61) on the side that is turned from said plane (7) down in its lower part is formed with a shelf (57) which forms said resting surface (26) and serves as a rest in elevation for the wrist, while the lower part of the control stick (54; 60) is so formed on the side turned towards the plane, that it can be gripped by at least the little finger and serve as a rest horizontally, and with said rest as a reference the driver can feel the steering movements.

14. An automobile steering control according to claim 12 or 13, c h a r a c t e r i z e d in that the lower control stick part (60; 43) is so arranged that it is rigid during steering movements within an inner angular range around the neutral position; but follows the upper control stick part (61; 42) during steering movements outside the inner angular range.

15. An automobile steering control according to claim 12 or 13, c h a r a c t e r i z e d in that the lower control stick part (43; 54) is arranged to follow the movements of the upper control stick part (42; 53) in a down-geared relationship.

16. An automobile steering control according to claim 12 or 13, c h a r a c t e r i z e d in that the lower control stick part (43; 54) is arranged to be rigid.

17. An automobile steering control according to claim 12 or 13, c h a r a c t e r i z e d in that the lower control stick part (43; 54) is arranged to follow the movement of the upper control stick part (42; 53) according to an unlinear function meaning little movement in the lower control stick part for small steering deflections on the upper control stick part and gradually increasing movement

in the lower control stick part for big steering deflections on the upper control stick part.

18. An automobile steering control according to any one of claims 12-15 or claim 17, c h a r a c t e r i z e d in that the lower control stick part (43; 54; 60) is swingable about an axle (45) that is concentric with the axle (15') of the upper control stick part (42; 53; 61).

19. An automobile steering control according to claim 14, 15 or 17, c h a r a c t e r i z e d in that a secondary transmission device (56) is arranged to detect the movement of the lower control stick part (43; 54).

20. An automobile steering control according to any one of claims 1-4, 7-9 or 11-19, c h a r a c t e r i z e d in that the control sticks (5, 6) are symmetrically arranged relative to said plane (7), preferably as reflected images of each other in the plane.

21. An automobile steering control according to any preceding claims, c h a r a c t e r i z e d in that the control sticks (5, 6), the axles (14, 15; 45) and the coupling device (13) are movably suspended from a bracket (10), going out from a rigid part (11) in the automobile body in front of the driver's seat (8).

22. An automobile steering control according to claim 21, c h a r a c t e r i z e d in that the bracket (10) has a box-shaped housing (9) which surrounds the axles (14, 15; 45), the coupling device (13) and said transmitter (28, 56), and which in its side sections that go passed the control sticks, (5, 6) forms cavities open at the sides (68) for the control sticks and the driver's hands.

23. An automobile steering control according to claims 8 and

22, c h a r a c t e r i z e d in that the control sticks (5, 6) are connected to the axles (14, 15; 45) through U-formed elongation parts (23, 24) going out from the upper and/or lower ends of the control sticks.

24. An automobile steering control according to claim 22, c h a r a c t e r i z e d in that the control sticks (5, 6) together with the box-formed housing (9) is adjustably displaceable relative to the rigid automobile body part (11) in directions parallel to said plane (7).

25. An automobile steering control according to any preceding claims, c h a r a c t e r i z e d in that the steering control has damping means (34) which have a mechanical connection to the control sticks (5, 6) and to an immobile part in the bracket (10) in order to have a damping effect on the movement of the control sticks, especially on quick steering deflections.

26. An automobile steering control according to any preceding claims, c h a r a c t e r i z e d in that the steering control has means (37, 38) so arranged that during steering movements they generate a force which works to bring back the control sticks to the neutral position.

27. An automobile steering control according to any preceding claims, c h a r a c t e r i z e d in that on at least one of the control sticks (5, 6) there are controls or function switches (65, 66) which are accessible to the driver during driving the automobile and thereby gripping the control stick.

Fig 1

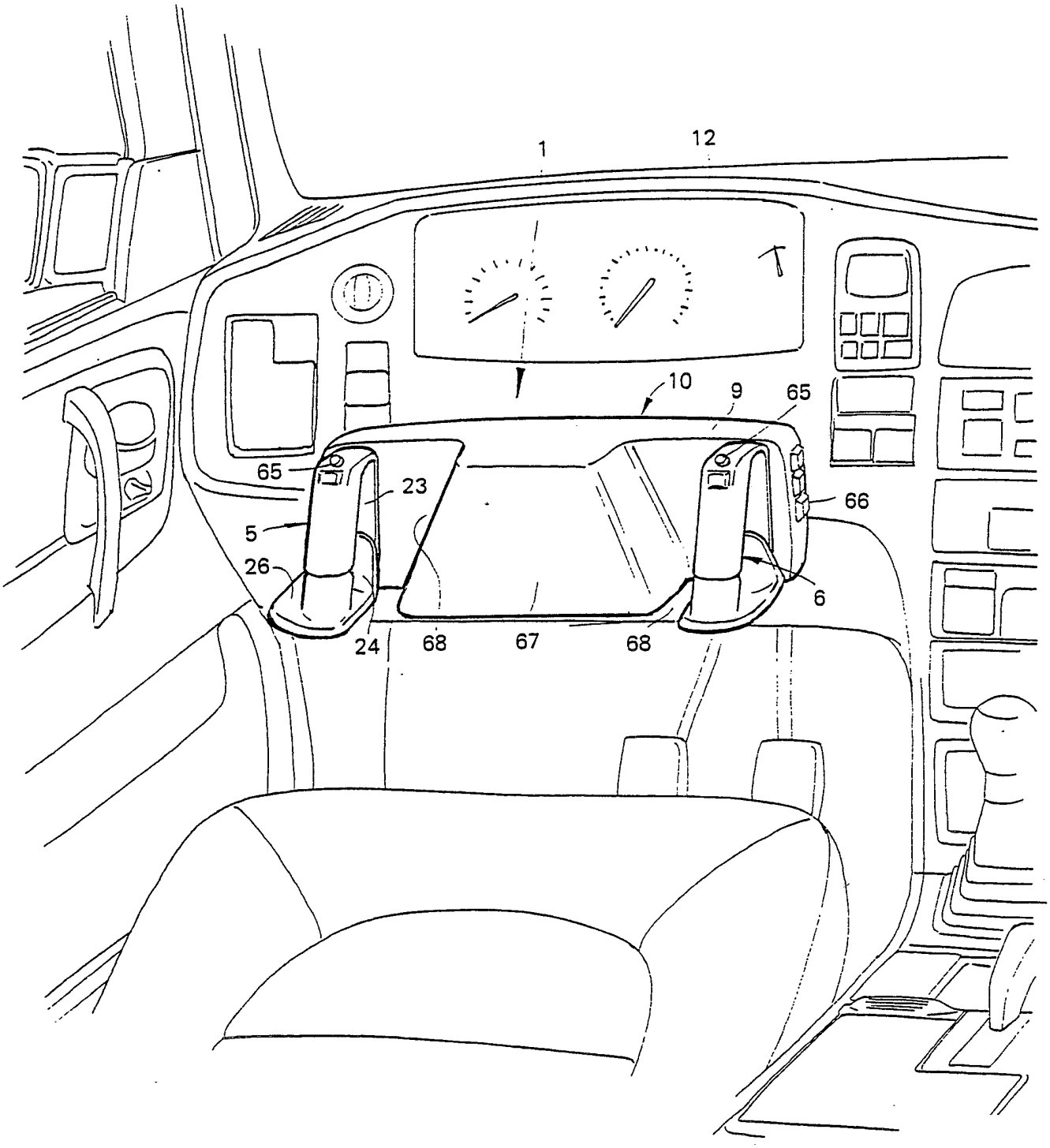
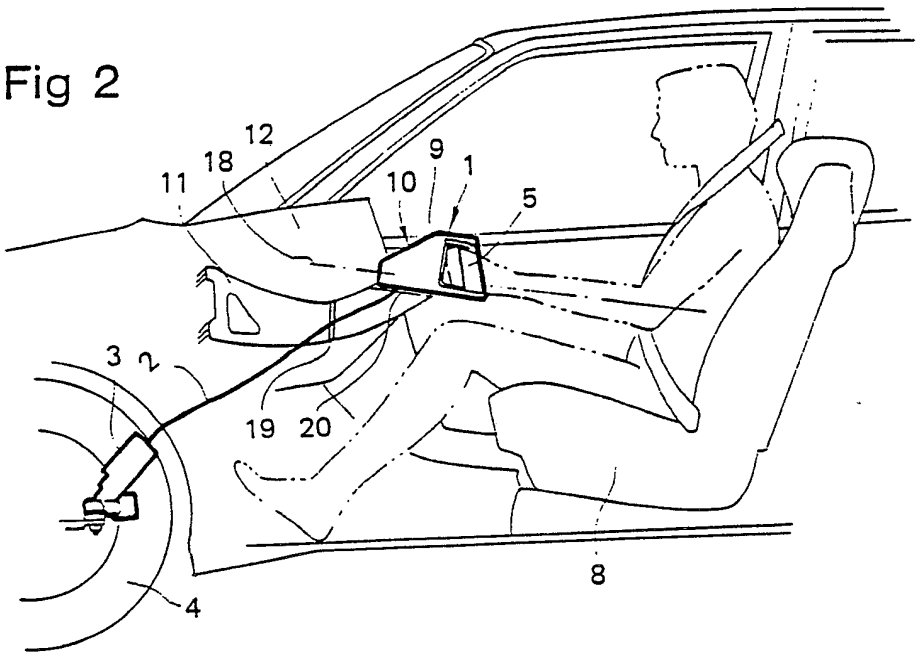


Fig 2



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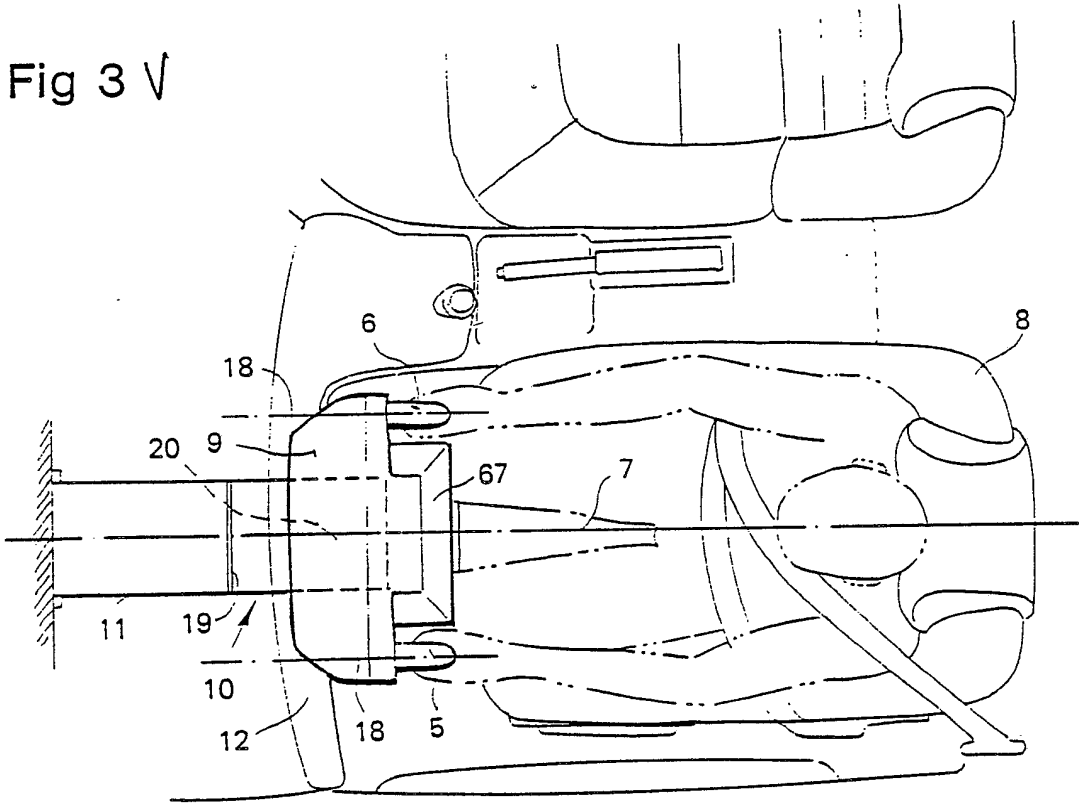

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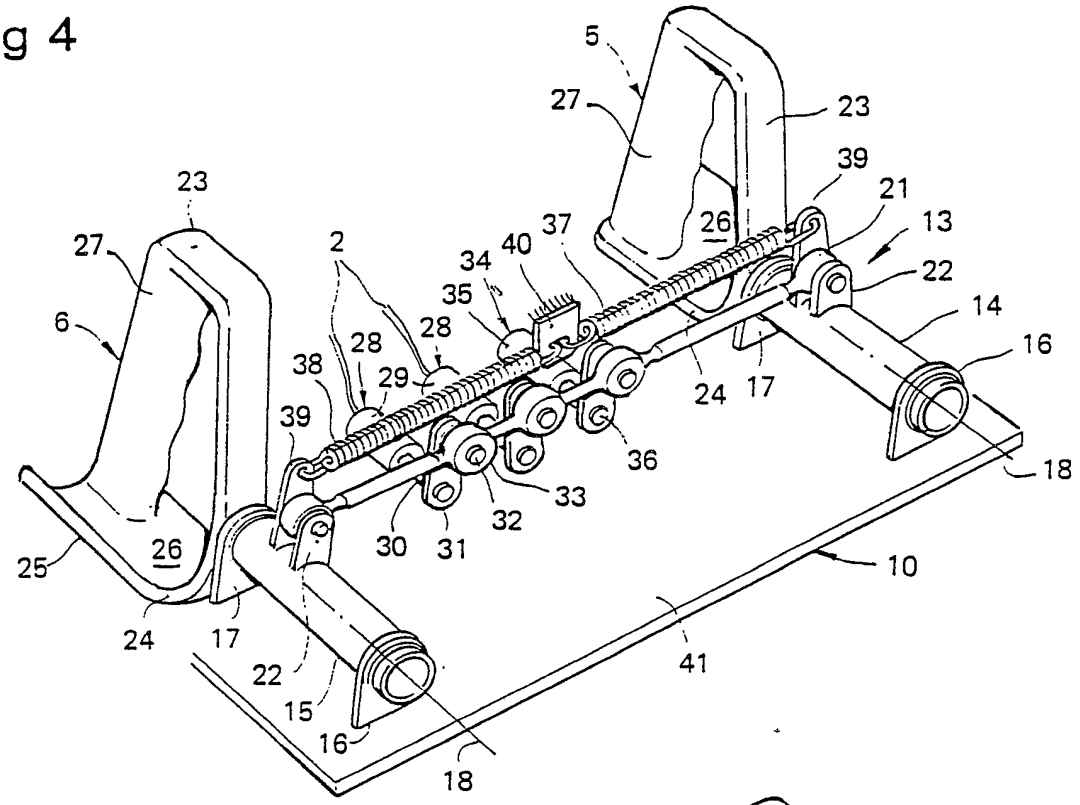
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Fig 6

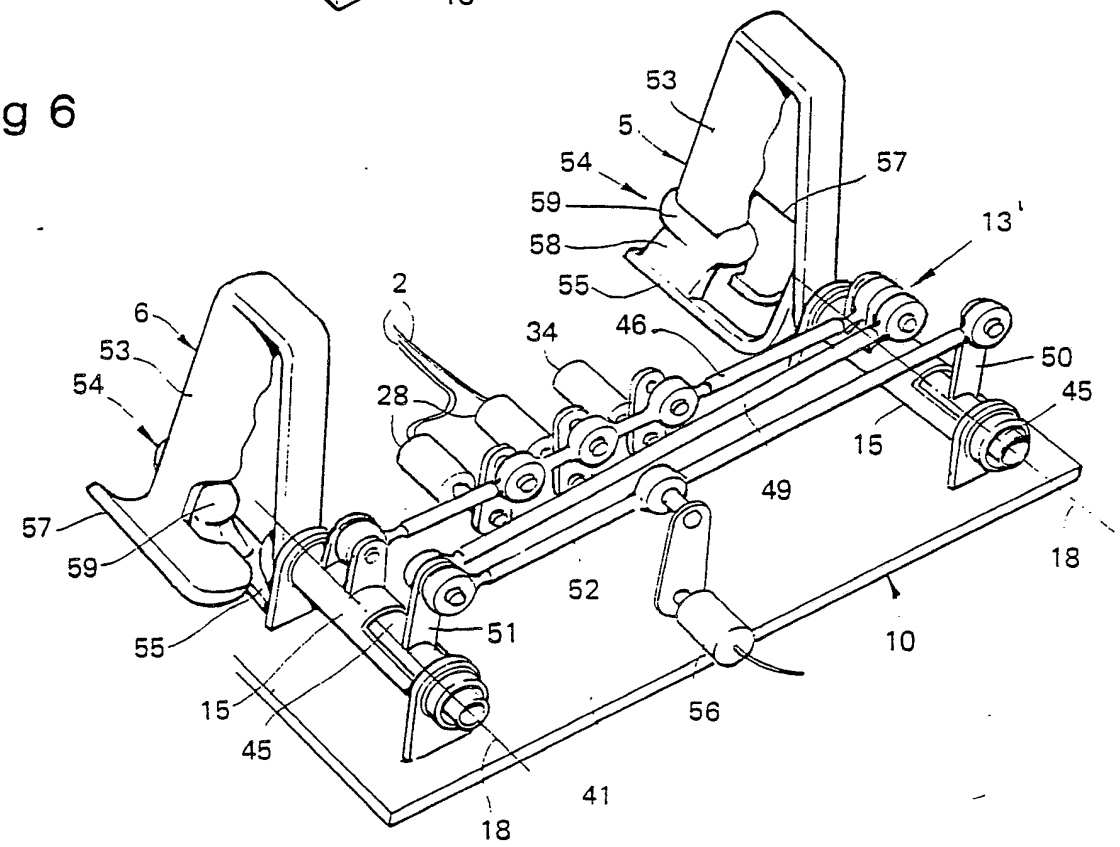
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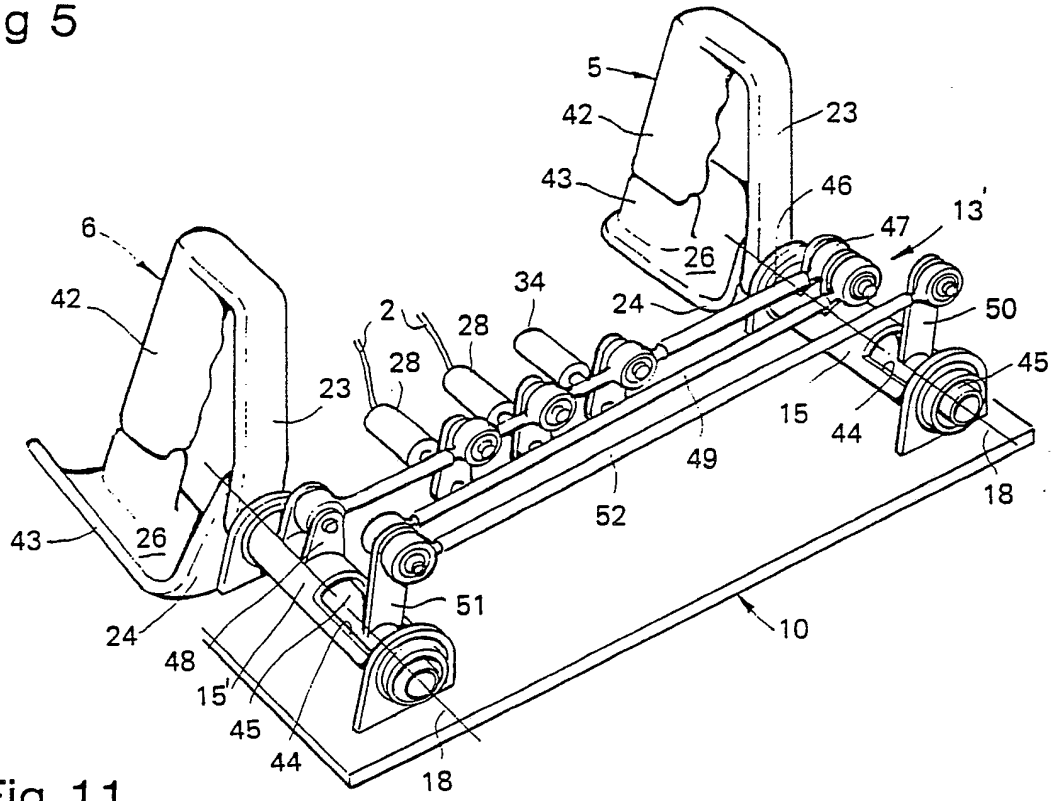
Fig 5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45
44
18

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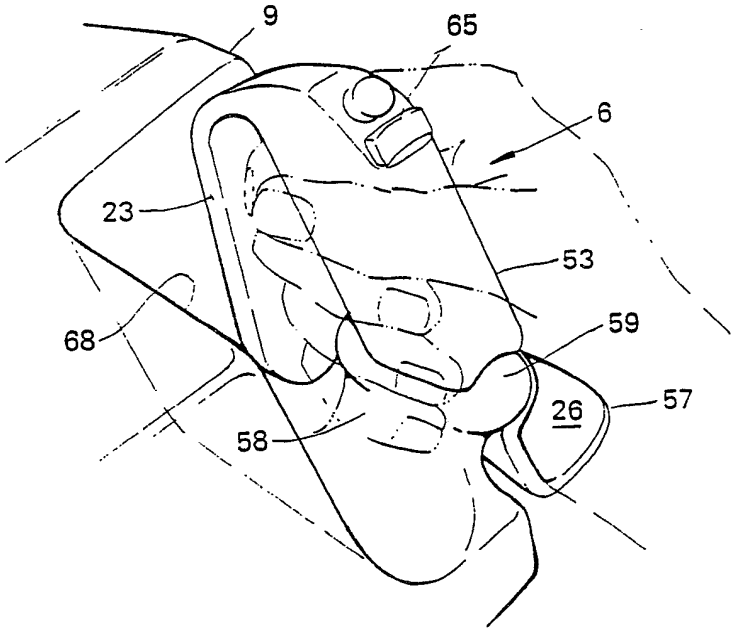
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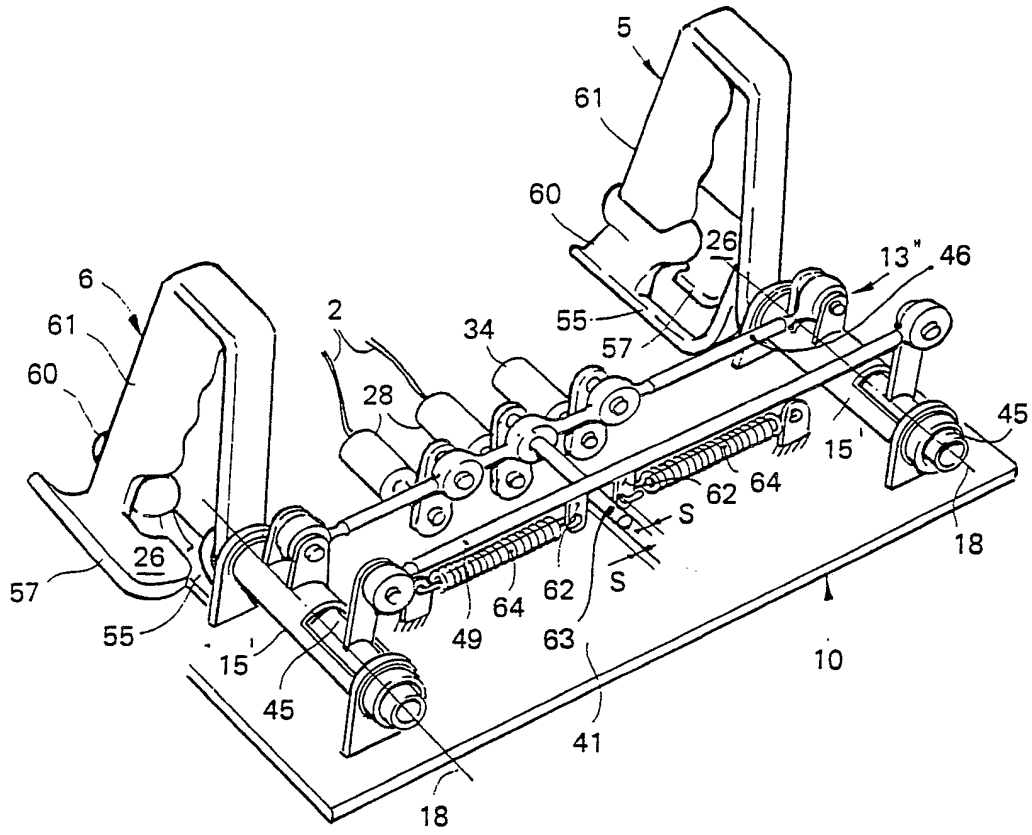
Fig 7


5
61
60
26
13"
46
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60
2
34
55
57
28
45
15'
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64
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18
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55
15'
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49
64
62
63
S
10
41
18

Fig 8

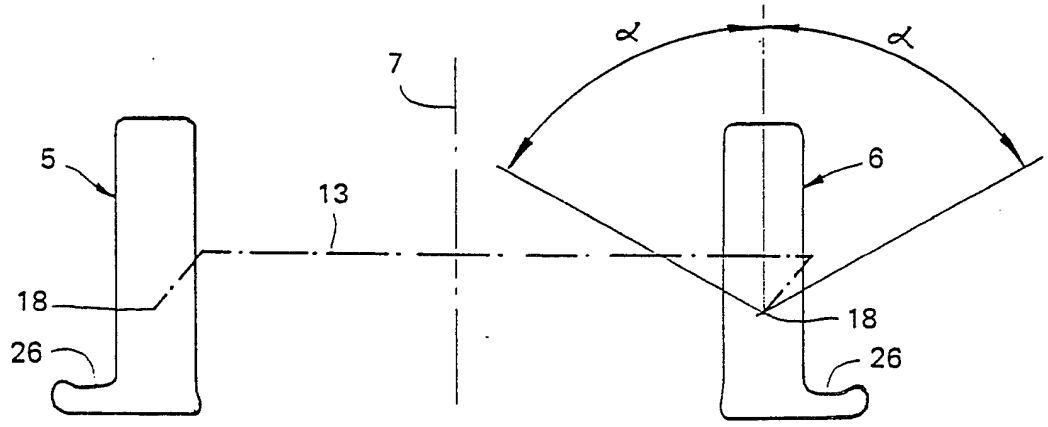


Fig 9

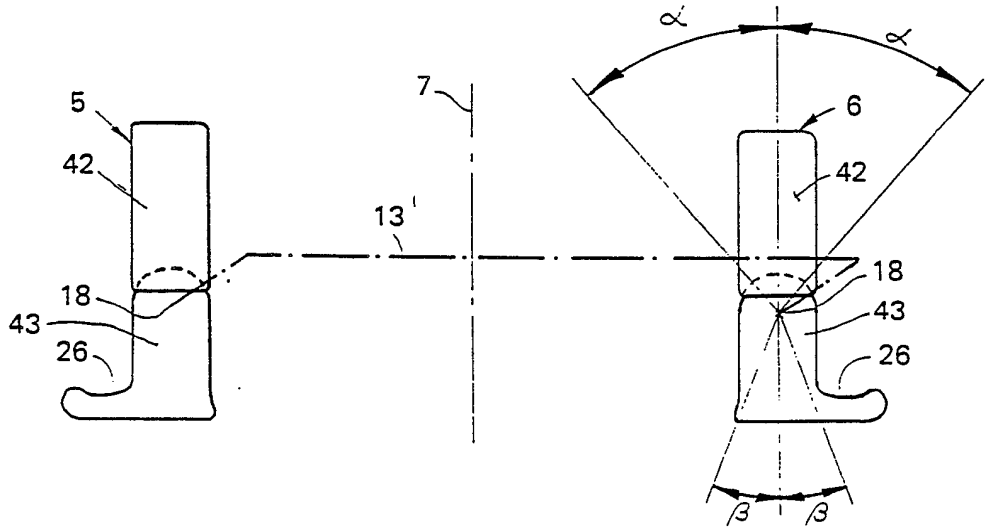


Fig 10

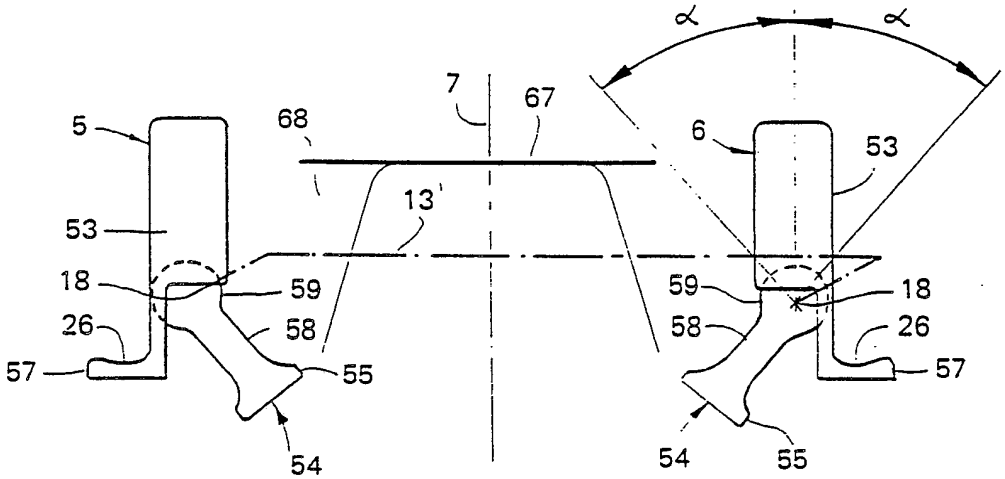


Fig 12

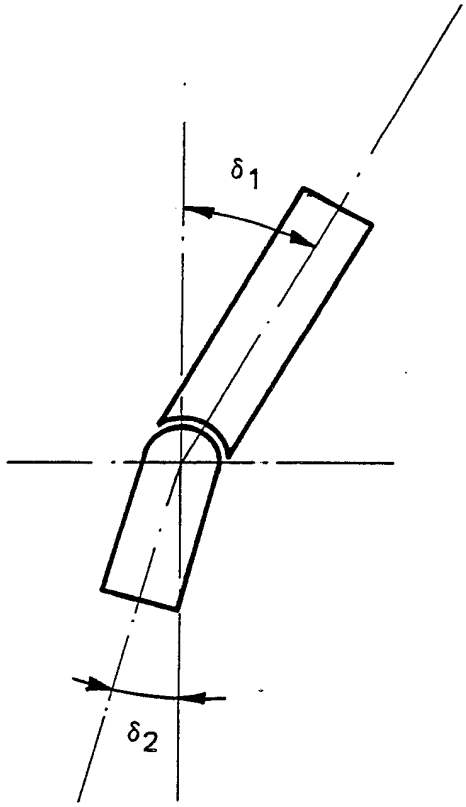


Fig 13

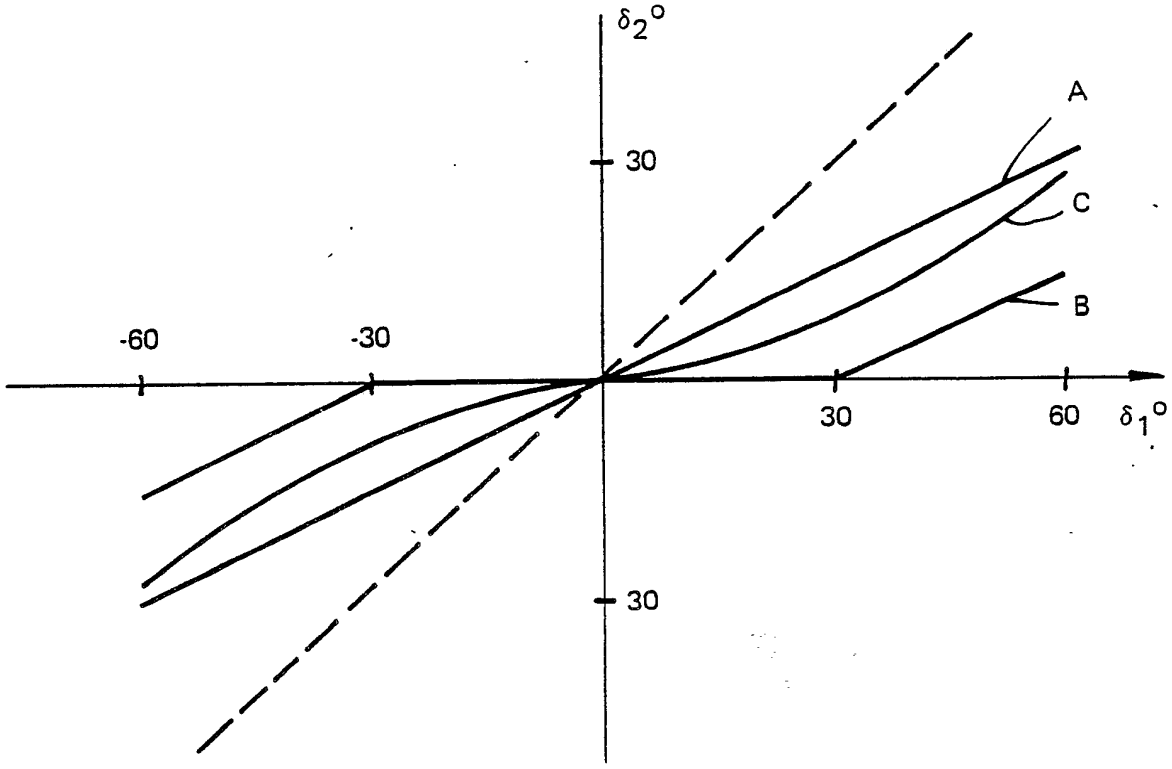
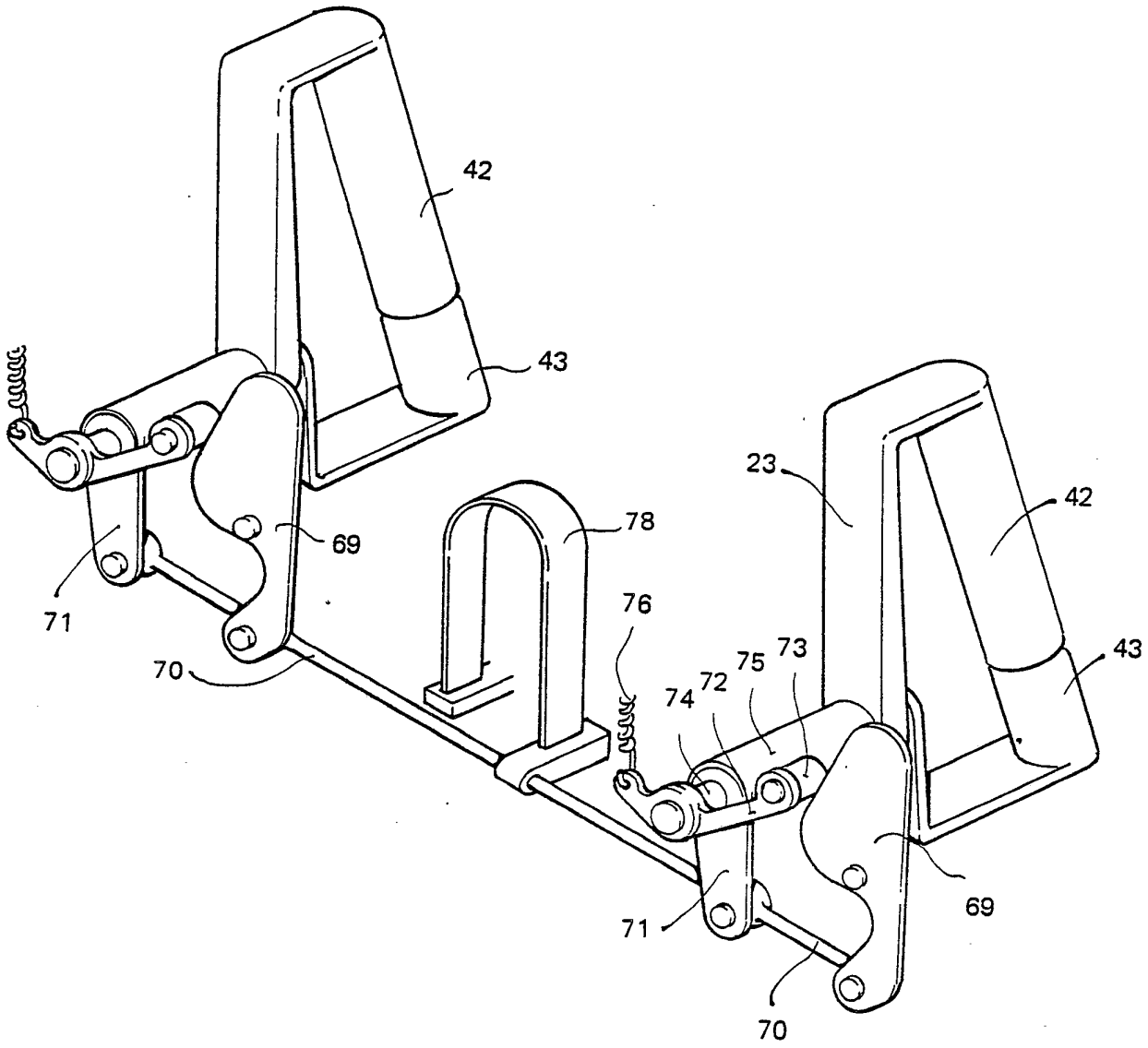


Fig 14



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE88/00284

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 62 D 1/12

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	B 62 D 1/12, /22 ; B 64 C 13/00- /04, /12, 19/00-/02; G 05 G 9/02, /04
US Cl	74:479,480,484-487,494 ; 244:83,84,234,236,237

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	SE, A, 431 433 (SAAB-SCANIA AB) 6 February 1984	
A	US, A, 3 726 497 (JAMES R. GARNETT ET AL) 10 April 1973	

* Special categories of cited documents: [10]

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1988-07-29	1988 -08- 16
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Johan Löfstedt